

# Selecting the Right Cleanroom Consumables

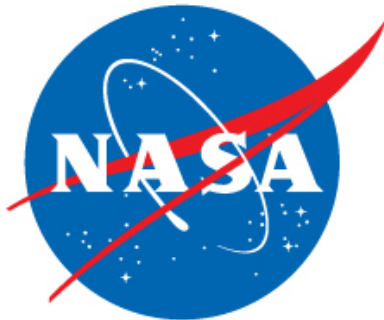


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## Jet Propulsion Laboratory

- Inhabits over 150 cleanrooms
  - Varies from ISO 4 to ISO 8.5
- Has over 1,000 clean equipment items, e.g. laminar flow benches

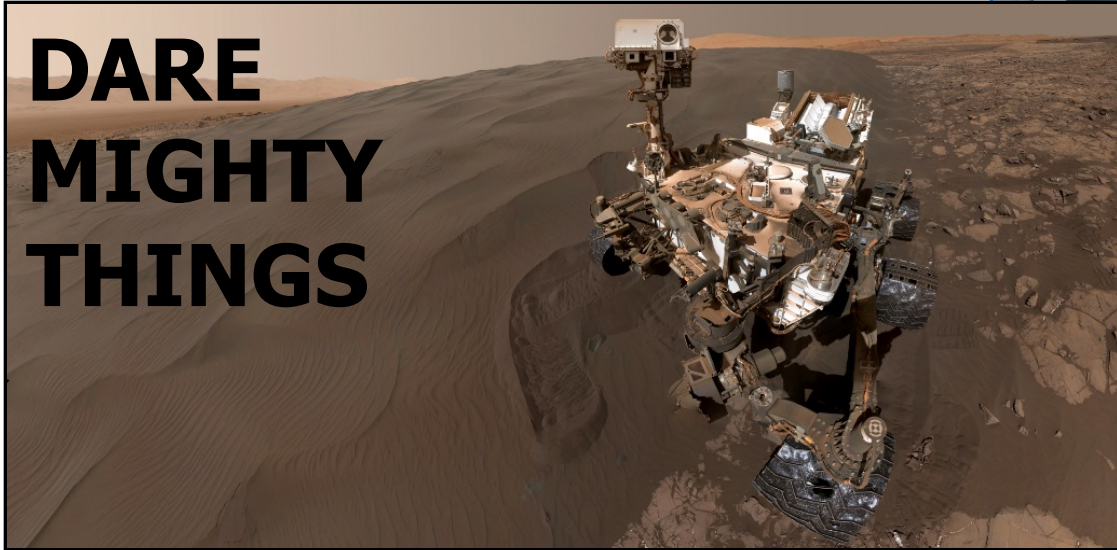


# JPL Cleanroom Usage

Some cleanrooms are for research



**DARE  
MIGHTY  
THINGS**

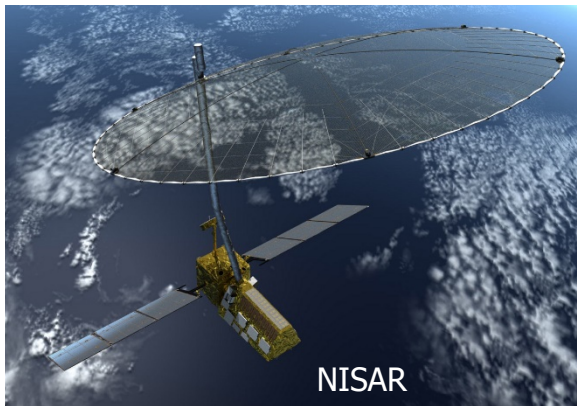


Others are for spacecraft and flight instrument assembly

Uniform Contamination Control (CC) requirements complex and difficult

# JPL Spacecraft and Instruments

Some spacecraft slated to study the Earth



Others will explore bodies that have the possibility of harboring alien life



CC requirements, and additional Planetary Protection (PP) requirements vary for missions

# JPL Infrastructure for Cleanrooms

- My Role as Cleanroom Engineer
  - JPL's SME (Subject Matter Expert) on cleanrooms
  - Train cleanroom users and managers
  - Control point for materials permitted in cleanrooms
  - To ensure cleanrooms meet requirements for specific missions' CC (Contamination Control), and PP (Planetary Protection), where relevant
  - Collaborate with:
    - Mission managers, engineers, and technicians
    - Cleanroom users and managers
    - JPL's "lab" (analytical chemistry lab)
    - Internal inventory "store" to sync expectations



# Selecting the Right Cleanroom Consumables

- Consumables list is long
  - Short-term or one time use consumables - gloves, wipers, shoe covers, hair nets, face masks, tape, ESD (Electro-Static Discharge) film, etc.
  - Long-term consumables - chairs, workstations, etc.
- Regular monitoring for cleanroom compatibility of consumables is a challenge
  - Suppliers manufacturing practices change
  - Suppliers manufacturing processes change



# Selecting the Right Cleanroom Consumables

- Selecting the consumables to fit every mission and every cleanroom needs is difficult
  - Some missions can have very stringent CC and PP requirements
  - While others have a less restrictive requirements
- Significant change in consumables can be slow

# Internal Requirements

- Established in order to meet most mission CC and PP requirements
- Material properties
  - $\leq 0.02 \mu\text{g}/\text{cm}^2$  volatile residue of AHC (Aphatic hydrocarbon) and Esters (common sources are from plasticizers and fingerprints)
  - $\leq 300$  PCL (Particulate Cleanliness Level per IEST-STD-CC1246E)
  - $\leq 0.002$  FPAC (Fiber Percent Area Coverage)
- No silicone!
- Plasticizers are minimized
  - Permitted due to ESD requirements

# Test Procedure Standards

- Carried out by internal lab
- For surface contamination they follow IEST-STD-CC1246E
- For very low outgassing properties JPL developed internal test process\*

\* James J. Herrick, James S. Dyer, Adrian R. Guy, Cynthia K. Lee, David M. Soules, and Mark S. Anderson "Analysis of semi-volatile residues using diffuse reflectance infrared Fourier transform spectroscopy", *Proc. SPIE 4774, Optical System Contamination: Effects, Measurements, and Control VII*, 11 September 2002



# Test Procedure (Cont'd)

- Test & validate consumables particle shedding & outgassing properties regularly
- Test for new potential consumables
- For surface contamination they follow IEST-STD-CC1246E

# Consumables Test Procedures

- Test procedures for the most common consumables include, but are not limited to
  - Duplicate true handling practices to determine maximum particle shedding
  - Testing for direct, secondary, and tertiary contact transfer
  - For outgassing internally developed process or ASTM standards followed
  - Additionally, utilize IEST-RP-CC005.4 (Gloves), IEST-RP-CC004.3 (Wipers), IEST-RP-CC003.4 (Garments)



# Practices in the Field

- In training and retraining remind users of consumable properties and limitations
- Do regular field checks to ensure the training material and methods are relevant and up to date, particularly with new cleanroom consumables

# Identifying Consumables

- Identifying best available commercial options
  - Selection of comparable items from different suppliers and test for compliance
  - Cost and material performance are used to determine the selection
  - Testing costs money and takes time, especially with the lab's busy schedule so have to limit the samples' quantity to reasonable number
  - Once best consumables for lowest cost selected inventory "store" can transition to new items

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Wednesday, May 1, 7 – 8 a.m.

Dessert, Networking, and Raffle Networking Event  
Wednesday, May 1, 1:30 – 3:25 p.m.

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# Thank you

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